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ever, be made between men and women of the same graduating classes. The average number of children of the married men in the same classes as the women is 1.7 as compared with 1.34 for the women. The total number of children of Wesleyan alumni, men and women, excluding duplicates, is 4,731. Of these 1,076 have been reported dead.

FRANK W. NICOLSON

#### *AN INDEX OF FISH ENVIRONMENTS*

IN studying the distribution and success of fishes within a given area, one often notes the absence of certain species from localities which appear quite suitable fish habitats upon inspection, or even upon determination of the oxygen content of the water. Evidently, the causes of this absence is not a life and death matter such as is often supposed to be true in animal distribution. But since fishes are able to move readily from place to place, they may leave or fail to enter a locality where the conditions are entirely compatible with life for a longer or shorter period. Yet the change in conditions may be great enough to cause the fishes either to turn back or to leave the locality because of stimulation and increased activity. Wishing to test this reaction possibility, we devised a means of studying the behavior of fishes when they encounter differences in gases or solids in solution. The apparatus consisted of a device giving a constant flow of water with desired amounts of dissolved gases, and at any temperature within ordinary experimental needs. Two tanks, 120 cm. long by 20.5 cm. wide by 14 cm. deep were arranged under identical and symmetrical surrounding conditions. Water was introduced into both ends of the tanks at the same rate and was allowed to flow out at the center. The same kind of water was introduced into the two ends of the control tank. In the experimental tank the water introduced at one end was like that of the control, while the gas content of that introduced at the other end had been experimentally modified. This established a gradient between the two kinds of water. Fishes put into the

tanks tend to go back and forth and thus encounter the experimental gradient. When the change of conditions thus encountered was such as to affect the fishes, they reacted either by turning back or by passing through the gradient into the treated water. But in this case they quickly returned to the untreated water, thus spending a shorter time in the treated water.

Eight species of fish, widely separated taxonomically, were studied in detail. All the fishes were slightly negative or indefinite in their reaction to differences in oxygen content. We found no good evidence that they react to nitrogen. Their reaction to water which had lost six parts per million of its salts (mainly magnesium and calcium), 15 c.c. of nitrogen and 2 c.c. of carbon dioxide per liter by boiling was about the same as to difference in oxygen content. All the fishes were decidedly negative in their reaction to increased carbon dioxide. The differences tried varied from 5 to 60 c.c. per liter above that in which the fish had been kept. When increased carbon dioxide accompanied low oxygen the negative reaction was very marked; the fishes turned back when the gradient was encountered and only rarely entered the part containing the highest carbon dioxide and lowest oxygen.

Several workers have shown that carbon dioxide is very toxic to fish. It appears to be much more so than corresponding differences (24 c.c. per liter) in oxygen content. Fishes turn away when they encounter an increase of as little as 5 c.c. per liter. Since a large amount of dissolved carbon dioxide is commonly accompanied by a low oxygen content, and other important factors, the carbon dioxide content of water (strongly alkaline waters excepted) is probably the best single index of the suitability of that water for fishes. The methods and these results, as well as others, will be published in detail elsewhere as soon as they can be prepared. These aspects of the results are sufficiently different from what workers appear to have been expecting to justify their publication here on account of

possible bearing on field studies during the present season.

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#### THE RELATION OF THE HORSEPOWER TO THE KILOWATT<sup>1</sup>

THERE was, before 1911, no precise definition of the horsepower that was generally accepted and authoritative, and different equivalents of this unit in watts are given by various books. The most frequently used equivalent in watts, both in the United States and England, has been the round number, 746 watts; and in 1911 the American Institute of Electrical Engineers adopted this as the exact value of the horsepower. It is obviously desirable that a unit of power should not vary from place to place, and the horsepower thus defined as a fixed number of watts does indeed represent the same rate of work at all places. Inasmuch as the "pound" weight, as a unit of force, varies in value as  $g$  the acceleration of gravity varies, the number of foot-pounds per second in a horsepower accordingly varies with the latitude and altitude. It is equal to 550 foot-pounds per second at 50° latitude and sea level, approximately the location of London, where the original experiments were made by James Watt to determine the magnitude of the horsepower.

The "continental horsepower," which is used on the continent of Europe, differs from the English and American horsepower by more than 1 per cent., its usual equivalent in watts being 736. This difference is historically due to the confusion existing in weights and measures about a hundred years ago. After the metric system had come into use in Europe, the various values of the horsepower in terms of local feet and pounds were reduced to metric units and were rounded off to 75 kilogram-meters per second, although the original English value was equivalent to 76.041 kilogram-meters per second. Since a unit of power should represent the same rate

of work at all places, the "continental horsepower" is best defined as 736 watts; this is equivalent to 75 kilogram-meters per second at latitude 52° 30', or Berlin. The circular gives tables showing the variation with latitude and altitude of the number of foot-pounds per second and of kilogram-meters per second in the two different horsepowers.

These values, 746 and 736 watts, were adopted as early as 1873 by a committee of the British Association for the Advancement of Science. The value, 0.746 kilowatt, will be used in future publications of the Bureau of Standards as the exact equivalent of the English and American horsepower. It is recognized, however, that modern engineering practise is constantly tending away from the horsepower and toward the kilowatt. The Bureau of Standards and the Standards Committee of the American Institute of Electrical Engineers recommend the kilowatt for use generally instead of the horsepower as the unit of power.

#### THE IMPERIAL UNIVERSITIES CONGRESS

THE Imperial Universities Congress was opened by Lord Rosebery on July 2, at the University of London, South Kensington. As we learn from the reports in the *London Times* the question of the division of work and specialization among universities was dealt with in a paper by Sir Alfred Hopkinson, and Sir Arthur Rücker and Sir Charles Waldstein spoke on the same subject. Principal Peterson, of McGill University, introduced a discussion on inter-university arrangements for post-graduate and research students.

On July 3 there were two sessions of the congress, Lord Curzon of Kedleston presiding in the morning and Mr. Balfour in the afternoon. Papers were read on the relation of the universities to technical and professional education, the interchange of university teachers, and the problem of universities in the east. The speakers and readers of papers included Sir Frederick Lugard, Sir Isambard Owen, Dr. A. E. Shipley, Sir Thomas Raleigh and

<sup>1</sup> Abstract of Circular of the Bureau of Standards, No. 34; June, 1912.